Space Weather Forecast

Issued on Sunday, 15 January 2023 at 12:41 Local

This forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Further Minor/Moderate Radio Blackouts (R1/R2) expected throughout. Risk Minor Geomagnetic Storm G1 rising from midweek.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been high over the last 24 hours, with three Moderate-class X-ray flares observed. The largest of these events gave a Moderate Radio Blackout R2 at 14/0341UTC from an emerging sunspot region in the northeast. Two further Moderate-class flares were observed, with these emanating from a sunspot in the southwest and giving R1 Minor Radio blackouts at 14/2006UTC, and 14/2037UTC. Both of these R1-generating flares were associated with a resulting Coronal Mass Ejection (CME). All of the above activity came during hours of darkness for Europe, with the effects of the blackouts limited to the sunlit portions of the Earth.

The facing side of the Sun remains highly congested in terms of sunspot regions, particularly the eastern solar horizon, with eight groups present - including the aforementioned. Another spot group faded away in the northwest quadrant in the 24 hours, but the population of the Earth-facing side of the Sun was otherwise largely maintained, with the emergence of up to three additional rapidly-developing, but for the moment small, magnetically bipolar regions.

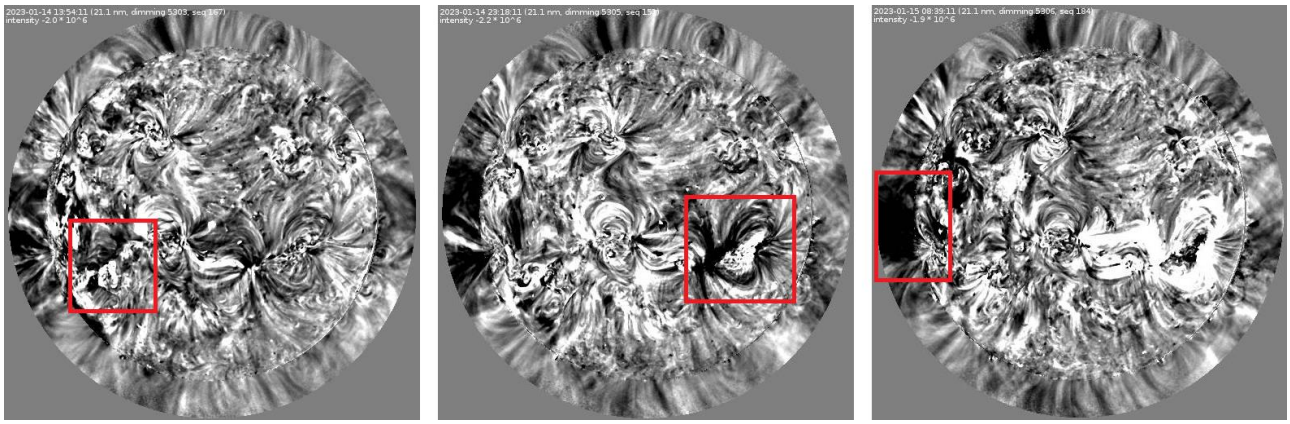

Figure 1: Time-integrated extreme UV satellite imagery of the most likely three Coronal Mass Ejection (CME)-generating events in the 24-hour period (processing courtesy of SIDC ROB). Respectively these are the 14/1246UTC flare and CME which has been assessed as a miss; the twin Moderate-class tied CME around 14/2000UTC – this may affect Earth late on Wednesday 18 January and into Thursday; and finally the 15/0341UTC Moderate-class flare and CME which is pending modelling results but is likely too far behind the Earth's position in the track of its orbit for any effect here.

There were three main events visible in available satellite imagery in the past 24 hours. Firstly, there was a 'disappearing filament' (arc of plasma ejected from the Sun) triggered by activity in the southeast. This has been analysed and is a likely miss to no effect at Earth. Secondly, there was a

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clear 'partial halo' signature associated with a lift-off near on of the larger and more active regions as a result of the two consecutive Moderate-class flares. This feature has been analysed and suggests a risk of affecting Earth at the very end the UTC day of Wednesday 18 January, with effects ongoing into Thursday. Finally, a third visible CME was observed heading largely below and behind the track of the Earth in its orbit associated with the 15/0341UTC flare, with this feature analysed and MOSWOC modelling results pending at the time of writing - although provisionally this feature is considered relatively unlikely to present a significant risk.

Solar Wind / Geomagnetic Activity: The solar wind showed a slight discontinuity in some measures around 14/1700UTC, with subsequent behaviour possibly suggesting the effects of a CME are in course, with this possibly associated with activity on the northwest of the Sun on 11 January, although this link is conjectural. This would follow on the heels of an earlier transient passing earlier in the UTC weekend stemming from a 09 January CME, and the tail of the modest fast wind.

The solar wind speed trace was rather noisy in the 24 hours, but showed a gradual decline from Elevated levels to Slightly Elevated with time. The number of particles comprising the solar wind appeared a little above its usual range, albeit with a flat trend. The main changes in the period were observed in the magnetic field tied to the particles, which underwent a marked change from being small-scale and weakly co-aligned with Earth's field in terms of the north-south component prior to 14/1700UTC, but transitioning to more strongly anti-aligned thereafter.

The net result of the above solar wind measures was an increase in activity relative to the preceding 24 hours, with a late revision upwards (after the fact due to late arriving data) to a provisional G1 in the 00-03UTC interval, else being quieter.

Energetic Particles / Solar Radiation: There was a very slight enhancement to solar radiation although the population of greater than 10MeV protons did not even reach 1pfu, where 10pfu is S1. The cause is not clearly attributable to any front-side event, and given the slow rise and damped spectrum, may be related to far-side activity.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be moderate, with a daily slight chance of strong-class flares. Although one of the more active regions departs the front side by midweek UTC, the sheer weight of current and expected eastern solar hemisphere arrivals should serve to compensate, and the trend is flat, all else being equal (i.e. no growth or decay).

Solar Wind / Geomagnetic Activity: Earth is currently experiencing the tail of a fast wind, overlaid with probable 09 January CME influence, and possible 11 January CME influence. All these should fade into the new working week to leave a quieter period in terms of geomagnetism. On day four, Wednesday 18 January, a weak fast wind may arrive as well as a possible late contribution from the 14/2000UTC-emitted CME to end the UTC day. The midweek event should represent the peak chance of Minor Geomagnetic Storm G1 for the period, although much of this risk should follow into Thursday.

Energetic Particles / Solar Radiation: The chances of solar radiation storms are likely to remain at predominantly background levels, but with a chance of enhancements which could produce an S1 or greater event through the period due to the number of magnetically complex sunspot regions - both on the Sun and narrowly over the well-connected (with Earth) western solar horizon.

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Geomagnetic Storms:

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	10	1	1	25
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Radio Blackouts - X Ray Flares:

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	Yes	80	80	80	80
Very Active	R3 to R5 X	No	20	20	20	20

Solar Radiation Storms - (High Energy Protons):

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	30	30	30	30
Very Active	≥ S3 *	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

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